South West Regional Coastal Monitoring Programme

Beach Management Plan Report

Lyme Regis

BMP

2011

PLYMOUTH COASTAL OBSERVATORY

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Southwest Strategic Regional Coastal Monitoring Programme

Beach Management Plan Report 2011 – Lyme Regis

1. Introduction

This report focuses on data collected during the Southwest Strategic Regional Monitoring Programme and data collected by West Dorset District Council. As part of the programme the coastline is divided into coastal cells, which are in turn subdivided into coastal management units. Lyme Regis forms a part of coastal cell 6a. This report primarily focuses on 6aMU6 which covers Lyme Regis beach (Figure 1). Lyme Regis beach covers the area east from Monmouth beach and extends to west of Church Cliffs. The beach is comprised of sand and a gravel bank. The shoreline east of Cobb gate jetty is almost entirely made up of boulder. Preliminary investigative studies carried out at Lyme Regis by HR Wallingford (1997) and High point Rendel (1997, 1999) set out to clarify understanding of shoreline sediment, transport for a planned coastal scheme. These preliminary investigations were formed of a mixture of longshore drift computer models, sediment movement schematics and numerical modelling.

2. Past results and preliminary observations

According to the past modelling studies conducted by HR Wallingford, shingle material is susceptible to loss from the central section of Marine Parade beach (Figure 1). It has been observed that during easterly wave conditions, material at this location is carried offshore. Past studies have failed to ascertain if material transported offshore returns to the beach when wave conditions are optimal. (SCOPAC, 2004) In addition processes are heavily influenced by the Cobb Harbour Wall. This structure provides shelter for the harbour and intercepts littoral shingle from the west. A consequence of this is the accretion of material at Monmouth Beach in the west and decrease of material transported to the east.
An ebb current was observed along the beach frontage. This was found to flow from east to west before being conducted south via the north wall of the harbour, prompting concerns that fine sediment could be deposited into the Cobb Harbour entrance.
Sediment dynamics at the shingle beach section were deemed highly variable. This is due in most part to a sediment drift divide situated in the centre of beach, wave diffraction around the Cobb, the influence of rock ledges upon waves and the orientation of the shoreline. Sediment drift here has been found to be extremely sensitive to storm events (specifically storm water level), nearby rock ledge orientation and elevation (HR Wallingford, 2001).

The scheme implemented in the 1990's, sought to improve the coastal defences at Lyme Regis. Beach models were produced by HR Wallingford during this time to determine future sand movement on the basis of the planned improvements. Improvements included in the plan involved the construction of a rock armour extension at Beacon Rocks and replacement of the seawall, plus replenishment at Marine Parade beach. Further nourishment of the beaches comprising of both sand and shingle was carried out in 2005. Shingle for the proposed beach nourishment was dredged from the seabed, situated east to the Isle of Wight. Sand for the scheme was imported from land based sand pits in France.

The main objectives of the scheme were as follows:

- To make certain beach works contribute to ensuring slope stability
- To ensure current and nourished beach levels maintain a sustainable level.
- To provide protection to the seawall from a range of wave conditions, in order to prevent scour of the seawall toe.
- To ensure the aesthetic and recreational value of the seafront.

Based on the models, it was predicted by HR Wallingford that after storm events the shingle beach crest would be pushed upwards to the height of the seawall. It was suggested that these storm crests would need to be re-profiled post-storm when the need was required. There were concerns that sediment placed on the sand beach would migrate, leading to siltation within the harbour and behind Beacon Rocks. Modelling anticipated that sand from Cobb beach would naturally migrate to the shingle beach and vice-versa.

Wave conditions at Lyme Regis are difficult to model, due to both natural, man-made structures and the complex nature of the seabed (H R Wallingford, 2001). At the time of the preliminary studies it was concluded that wave conditions be modelled using a pre-existing model, TELURAY. It was considered that extending the model to include the shoreline would be the most practical option; in addition the model would represent a wide spectrum of wave directions. The results showed that wave direction at Lyme Regis is predominantly south westerly. Waves from a west-south-westerly direction produced the largest waves (HR Wallingford, 1993, 1994)

3. Beach Management Plan

In 2007 the first beach management plan for Lyme Regis was devised by High Point Rendell, on behalf of West Dorset District Council. The plan was based on the results and observations from post scheme surveys carried out by West Dorset District Council, monthly during 2006. The report specified that over the aforementioned period there had been little change to warrant further works and the beach was behaving as expected. A number of observations were noted from the results of the post scheme surveys from July 2006 to May 2007:

- As forecast by HR Wallingford, re profiling of the shingle crest had needed to take place after storm events. This was due to movement of material up into a bank above MHWS.
- Beach movement was negligible with significant movement of material only occurring during storm events.
- Sediment was noted to move westwards towards The Cobb. A net loss was noted through the central section of shingle beach. A net gain was noted at the western end of the sand beach.
- At the end of 2006 it was noted that the shingle beach had changed very little in terms of volume. The sand beach also had retained its volume however; it was observed that a very small amount of material had migrated into the harbour.
- Defences have been put in place to stabilise the cliffs, however known conditions such as high precipitation and construction works can cause cliff disturbances.

It should be noted that forecasts detailing the need for future beach nourishment were difficult to make due to the complexity of processes at Lyme Regis. It was recommended that the beach be monitored in the initial years of the scheme to gain scope of need for any future beach management works (HR Wallingford, 2001)

A number of beach maintenance recommendations were devised within the 2007 Beach Management Plan report:

- Beach maintenance should consist of beach re-profiling and nourishment where needed.
- Any beach work activities should be carried out during April, to coincide with the end of the winter storm period.
- Any nourishment or re-profiling activities should mimic the original beach profile as closely as possible.
- In the event material is dredged from Cobb Harbour, dredged material could be placed on lower beach slopes (depending on dredged sediment size)

In addition action should be taken if the following trigger points are reached:

- The shingle beach crest becomes unacceptably steep (1:2)
- The shingle beach crest is 1 metre higher than Cart Road
- The design profile for the Shingle beach crest (5 metres wide and a seaward slope of 1:7) cannot be achieved with pre-existing shingle
- Shingle accretes to within 3cm of the top of Cobb Gate Jetty
- The storm water outfall at Lister Gardens Jetty becomes significantly silted up with sand
- The sand beach reaches a critical level of 1.3 metres below Cart Road.
- The slipway at the western end of the sand beach becomes exposed.

Changes in this report are reported from the post scheme surveys in 2006 and subsequent surveys carried out by PCO until summer 2010. This data provides a short time base over which beach changes have been monitored. Detailed interpretation and decision-making is not advisable on the basis of these short-term changes, since the changes may not be representative of longer-term trends.

It must be appreciated that the accuracies of each measurement system must be taken into account when drawing conclusions, particularly from the difference models. In the case of topographic difference models from RTK GPS surveys, the accuracy of each data point is ±0.03m and therefore differences of ±0.06m can generally be considered as "real", whilst smaller changes may be an artefact of the measuring system, and are considered to be "No Change". Difference plots show changes >±0.25m, which should be indicative of areas of genuinely measurable change. Smaller changes may also be present but these are filtered from the analysis to provide clarity. This report displays difference models only where detailed analysis suggests that the changes are real but, nevertheless, the user should approach the results as indicative, unless reinforced overtime or with other information.

Where LiDAR has provided the source data sets, the modelling is less precise. Each LiDAR cell value has a plan position representative of a $1m^2$ grid. It is not reasonable to expect to observe changes with positional accuracy of better than 1-2m therefore. Profiles of steep slopes may suggest that the changes "bounce" back and forth. This is an artefact of the accuracy of the source data. LiDAR is particularly ineffective at identifying sharp edges or steep slopes *e*.g. cliffs, seawalls. Despite these limitations in accuracy the changes shown indicate an overview of profile change, but to a lower precision than the RTK data. The location of the regularly surveyed profiles superimposed on the difference plots indicates how representative these profiles might be of overall changes.

It *must* be emphasised that this is the first BMP report of a series and that changes identified are indicative only of short-term trends. As the programme progresses, more detailed and meaningful reporting will be possible. Accordingly, this report should be considered as a preliminary assessment.

4. Hydrodynamic data

a. Waves

A Directional WaveRider buoy was deployed at West Bay on the 1st November 2006.

The full wave reports are given at Annex A.

b. Tides

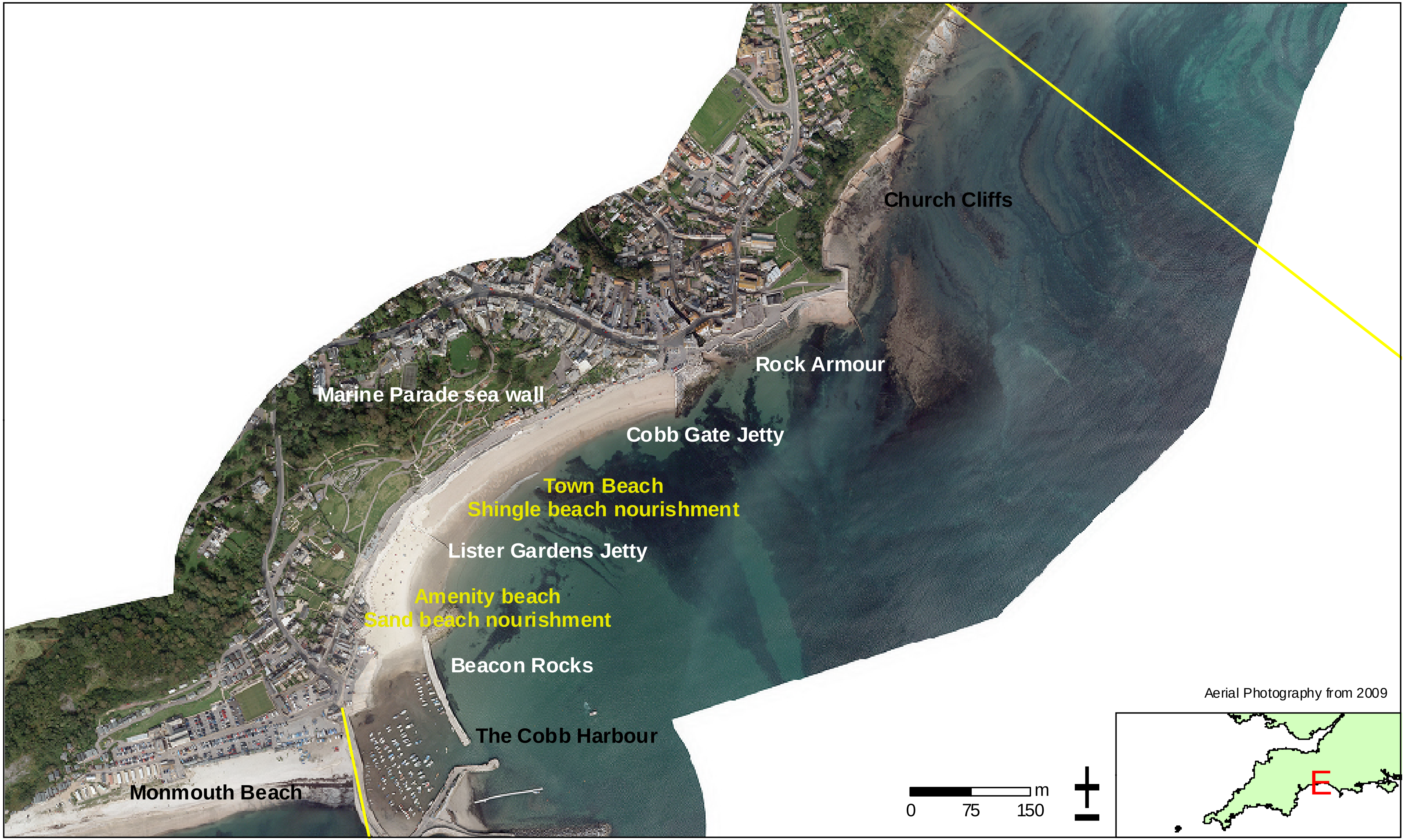
A WaveRadar Rex was installed at West Bay Harbour on 25th January 2008.

The full tide report is given at Annex B.

5. Survey data – bathymetric

The first baseline bathymetric survey of Lyme Bay was completed between June 2007 and October 2008. No further analysis will be carried out until after the next baseline survey in 2011. For this reason DTMs for each management unit where data have been delivered have been included in place of difference models. A side scan sonar survey conducted in April 2005 by West Devon District Council has been included within this report.

Annex A West Bay Interim Wave Report
Annex B West Bay Harbour Tide Report
Annex C N/A
Annex D N/A
Annex E N/A
Annex F Topographic Survey Report for Lyme Regis
Annex G N/A
Explanatory Notes


Church Cliffs
Rock Armour
Marine Parade sea wall
Cobb Gate Jetty
Town Beach
Shingle beach nourishment
Lister Gardens Jetty
Amenity beach
Sand beach nourishment
Beacon Rocks
The Cobb Harbour
Monmouth Beach
Aerial Photography from 2009
m
0
75
150
E

Chesil Directional Waverider Buoy

Location

OS: 363079E 78233N

WGS84: *Latitude:* 50° 36.157'N *Longitude:* 002° 31.384' W

Water Depth

~10.4m CD

Instrument Type

Datawell Directional WaveRider Buoy Mk III

Data Quality

C1(%)	Sample interval
96	30 minutes

Monthly Means

All times GMT

Chesil June 2008 to May 2009						
Month	H_s (m)	T_p (s)	T_z (s)	Direction (°)	SST (°C)	No. of days
June	0.70	7.6	4.2	226	14.3	28
July	0.93	6.8	4.1	222	16.1	30
August	1.13	6.5	4.2	224	17.1	30
September	0.88	7.1	4.6	204	16.4	29
October	1.18	7.1	4.6	223	14.6	31
November	0.98	7.2	4.4	216	11.7	26
December	0.86	8.1	5.0	215	9.0	29
January	1.41	11.4	5.9	214	7.3	30
February	0.77	11.8	5.4	215	7.2	28
March	0.85	8.6	4.5	221	8.1	30
April	0.75	8.6	5.0	223	9.9	29
May	0.90	8.1	4.6	215	12.1	31

Tables and plots of these values, together with the minimum and maximum values and the standard deviation are available on the website

5 Highest storm events in 2008/9									
Date/Time	H_s	T_p	T_z	Dir.	Water level elevation* (OD)	Tidal stage (hrs re: HW)	Tidal range (m)	Tidal surge* (m)	Max. surge* (m)
17-Jan-2009 22:30	4.43	8.3	6.9	231	1.53	HW +1	2.49	-	-
04-Oct-2008 22:00	4.37	8.3	6.9	225	1.36	HW +1	2.57	0.26	0.36
09-Nov-2008 21:00	4.28	9.1	6.8	224	-0.36	HW +5	1.45	0.08	0.31
13-Dec-2008 07:00	3.89	9.1	6.8	207	1.88	HW +1	3.26	-0.04	0.45
05-Jul-2008 20:30	3.82	10.0	6.8	229	2.06	HW +1	3.45	-0.04	0.53

* *Tidal information is obtained from the nearest recording tide gauge (the WaveRadar Rex at West Bay Harbour). The surge shown is the residual at the time of the highest H_s. The maximum tidal surge is the largest positive surge during the storm event.*

Distribution plots

The distribution of wave parameters is shown in the accompanying graphs of:

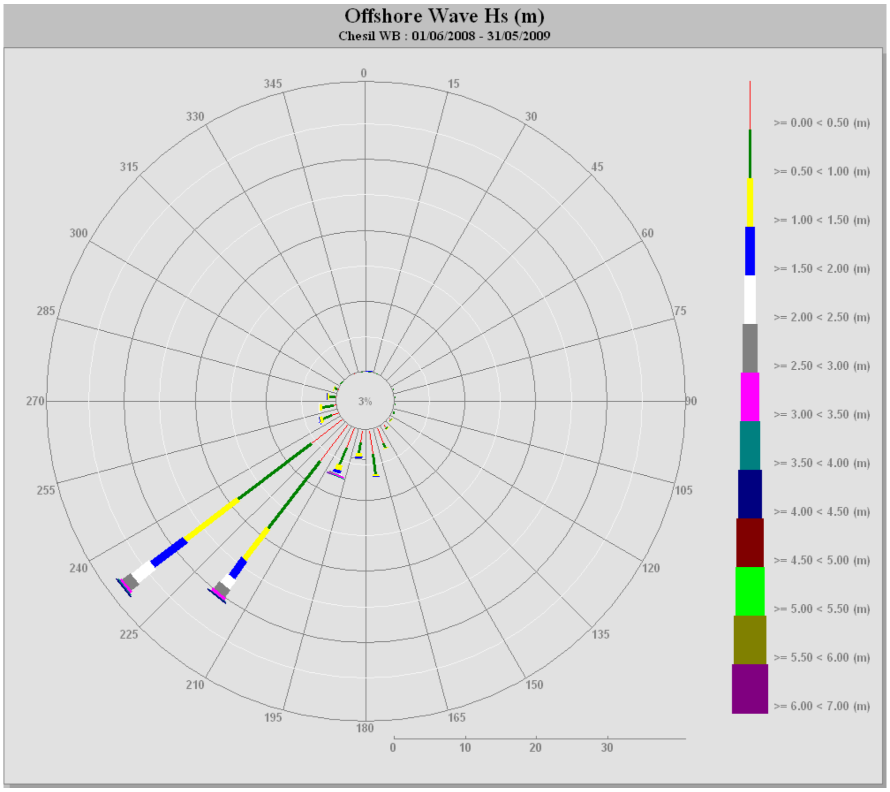
- Wave roses (Direction vs. H_s) from June 2008 to May 2009 and for all measured data
- Percentage of occurrence of H_s, T_p, T_z and Direction from June 2008 to May 2009
- Monthly time series of significant wave height (the red line is the storm threshold)
- Incidence of storms during the reporting period and all previous years. Storms are defined using the Peaks-over-Threshold method. The highest H_s of each storm is shown.

Summary

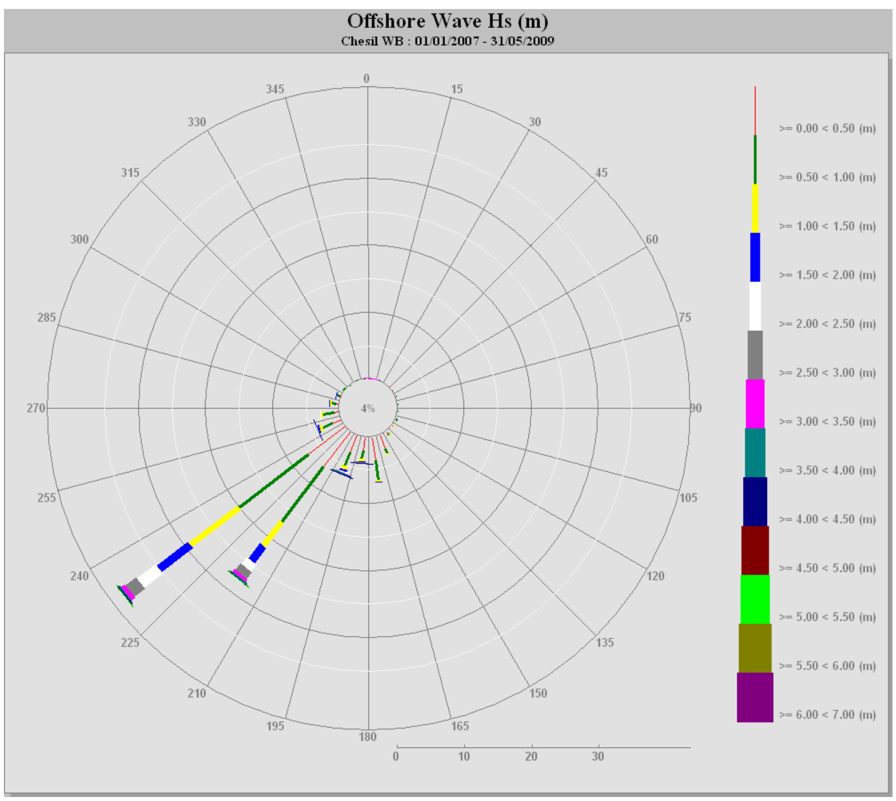
The buoy was deployed on 01 January 2007. During this reporting year there were considerably fewer storms exceeding the storm threshold than in the previous year, and the peak storm waves were lower than last year. Storm approach is generally from the South West.

Acknowledgements

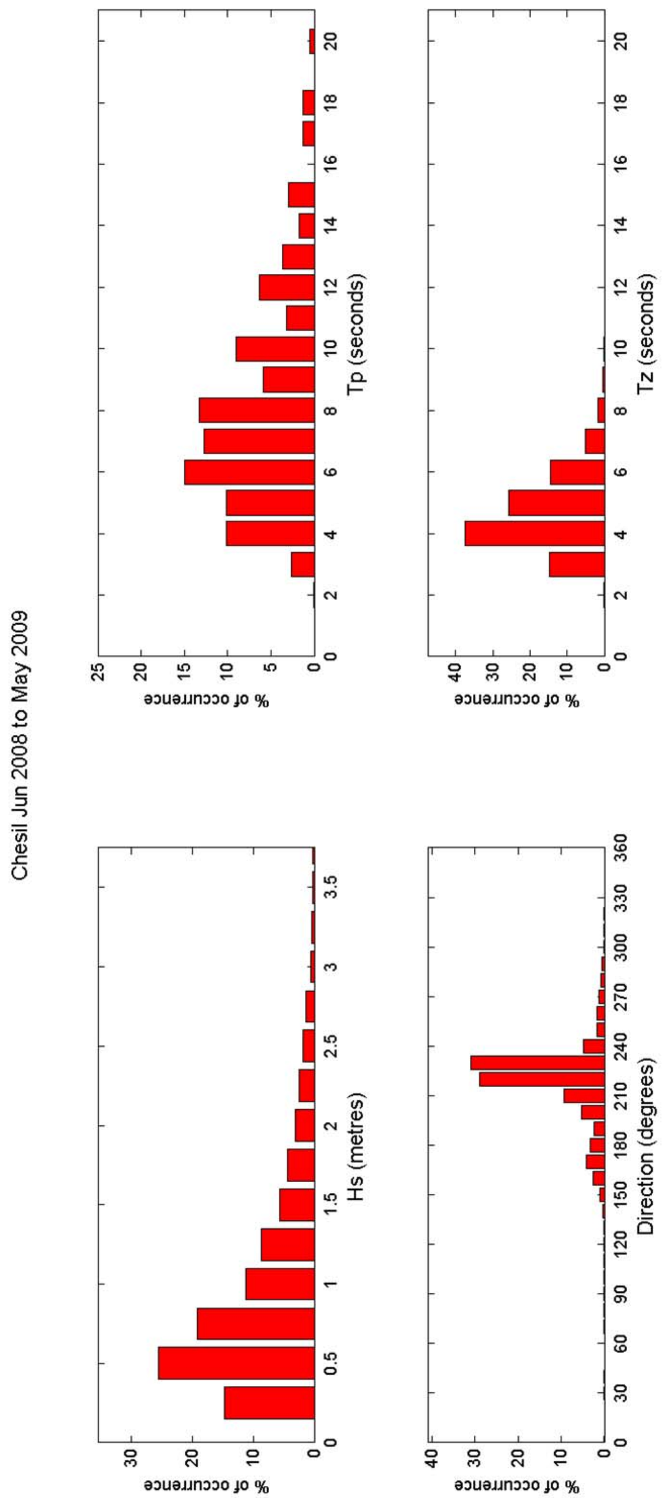
Task2000 tidal prediction software was kindly provided by the Permanent Service for Mean Sea Level, Proudman Oceanographic Laboratory.

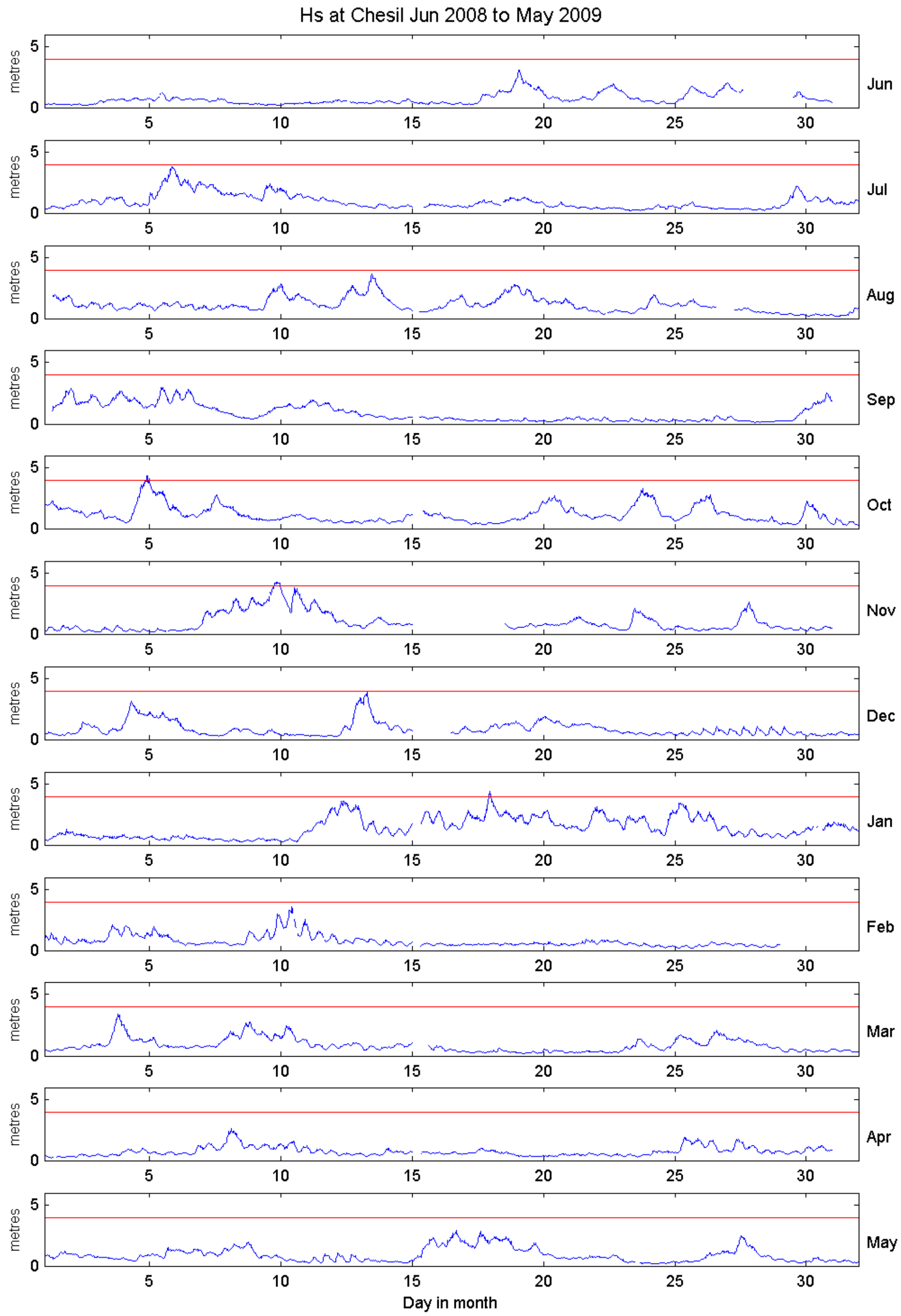


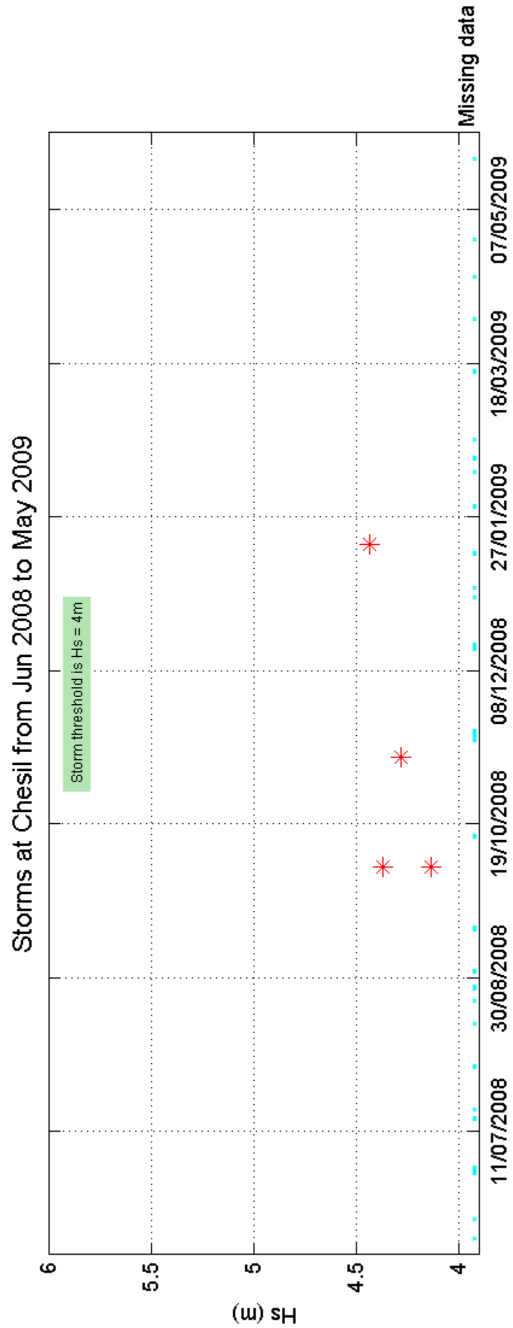
Direction vs. H_s for June 2008 to May 2009 (this reporting year)

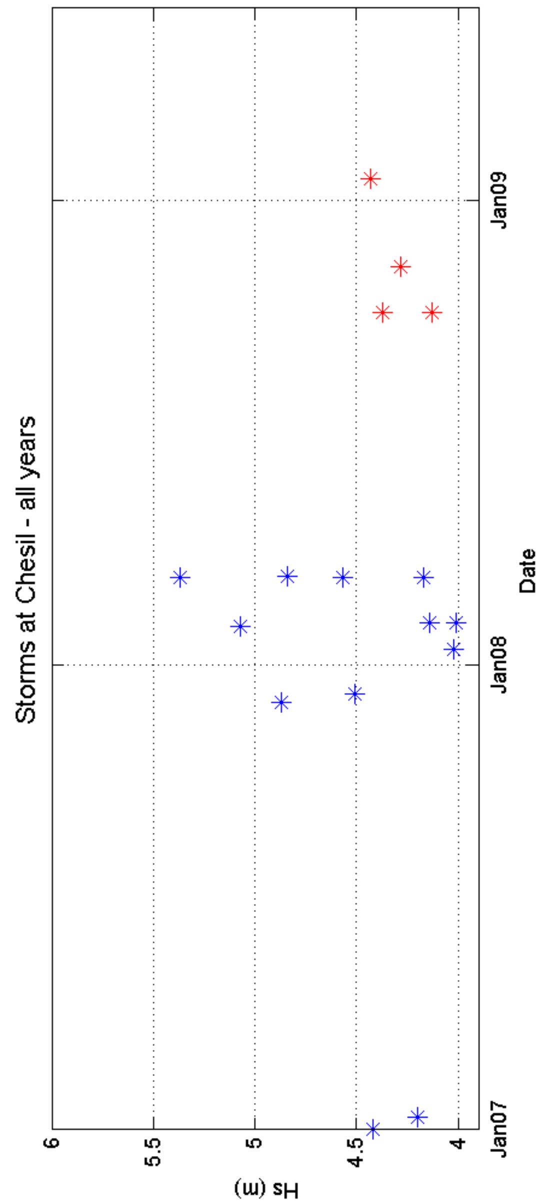


Direction vs. H_s for January 2007 to May 2009 (all measured data)


Chesil Jun 2008 to May 2009
% of occurrence
Hs (metres)
Tp (seconds)
Direction (degrees)
Tz (seconds)


Hs at Chesil Jun 2008 to May 2009
metres
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
0
5
10
15
20
25
30
Day in month


Storms at Chesil from Jun 2008 to May 2009
Storm threshold is Hs = 4m
Missing data
Hs (m)
6
5.5
5
4.5
4
11/07/2008
30/08/2008
19/10/2008
08/12/2008
27/01/2009
18/03/2009
07/05/2009


Storms at Chesil - all years
Hs (m)
6
5.5
5
4.5
4
Jan07
Jan08
Jan09
Date

West Bay Waverider Buoy

Location
OS: 347123 E 88451 N
WGS84: *Latitude:* 50° 41.596 ' N *Longitude:* 002° 44.998 ' W

Water Depth
Approx. 10m CD

Instrument Type
Datawell Waverider Buoy Mk III

Data Quality

C1(%)	Sample interval
96	30 minutes

Monthly Means

All times are GMT

West Bay June 2008 to May 2009						
Month	H_s (m)	T_p (s)	T_z (s)	Direction (°)	SST (°C)	No. of days
June	0.61	7.6	4.0	216	14.6	28
July	0.84	6.5	3.8	209	16.3	29
August	1.00	5.9	4.0	213	17.2	29
September	0.81	7.3	4.2	195	16.3	29
October	1.06	7.1	4.4	213	14.6	30
November	0.79	7.5	4.2	205	11.5	28
December	0.73	8.4	4.6	202	8.8	29
January	1.33	11.0	5.5	208	7.1	31
February	0.69	11.8	5.3	210	7.0	28
March	0.72	8.7	4.3	212	8.3	31
April	0.67	8.9	4.7	209	10.4	29
May	0.80	8.2	4.1	208	12.5	30

Tables and plots of these values, together with the minimum and maximum values and the standard deviation are available on the website.

Highest events in 2008/9									
Date/Time	H_s	T_p	T_z	Dir.	Water level elevation * (OD)	Tidal stage (hrs re HW)	Tidal range (m)	Tidal surge* (m)	Max. surge* (m)
17-Jan-2009 22:00	4.24	9.1	6.7	218	1.43	HW -1	2.49	-	-
04-Oct-2008 20:30	4.02	8.3	6.7	221	1.82	HW -1	3.11	0.26	0.51
13-Dec-2008 05:30	3.87	8.3	6.3	205	1.79	HW -1	3.54	-0.03	0.42
25-Jan-2009 03:00	3.82	8.3	6.3	207	0.73	HW -3	2.41	-	-
09-Nov-2008 19:30	3.77	8.3	6.5	215	-0.27	HW +5	2.09	0.29	0.43

* *Tidal information is obtained from the nearest recording tide gauge (the WaveRadar Rex at West Bay Harbour). The surge shown is the residual at the time of the highest H_s. The maximum tidal surge is the largest positive surge during the storm event.*

Distribution plots

The distribution of wave parameters is shown in the accompanying graphs of:

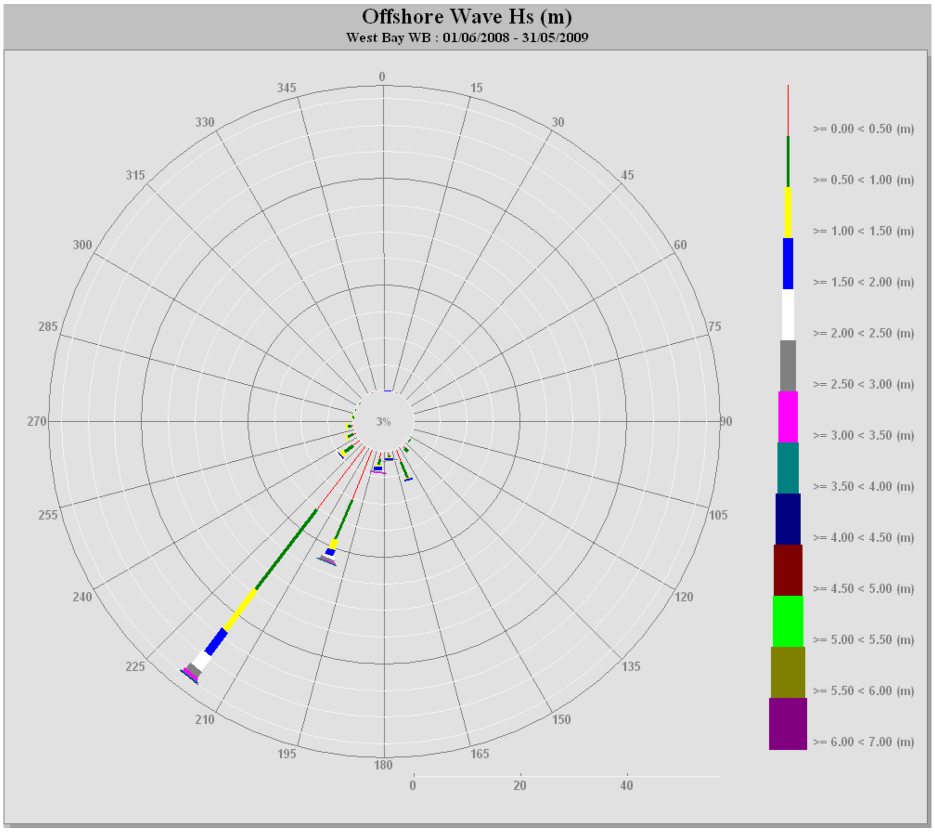
- Wave rose (Direction vs. H_s) for reporting year and for all measured data
- Percentage of occurrence of H_s and T_z from June 2008 to May 2009
- Monthly time series of significant wave height (the red line is the storm threshold)
- Incidence of storms during the reporting period and all previous years. Storms are defined using the Peaks-over-Threshold method. The highest H_s of each storm is shown.

Summary

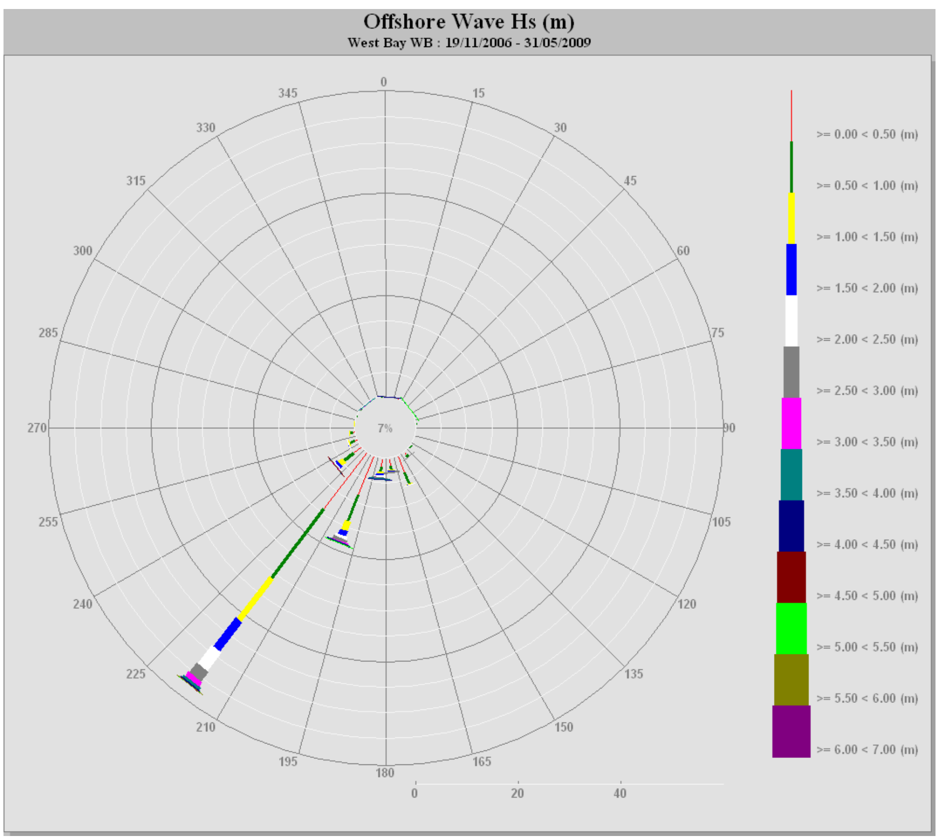
This reporting year experienced a similar number of storms as the last year, but with less high waves, and concentrated from October to March. Wave direction was predominantly from a SWbS direction.

Acknowledgements

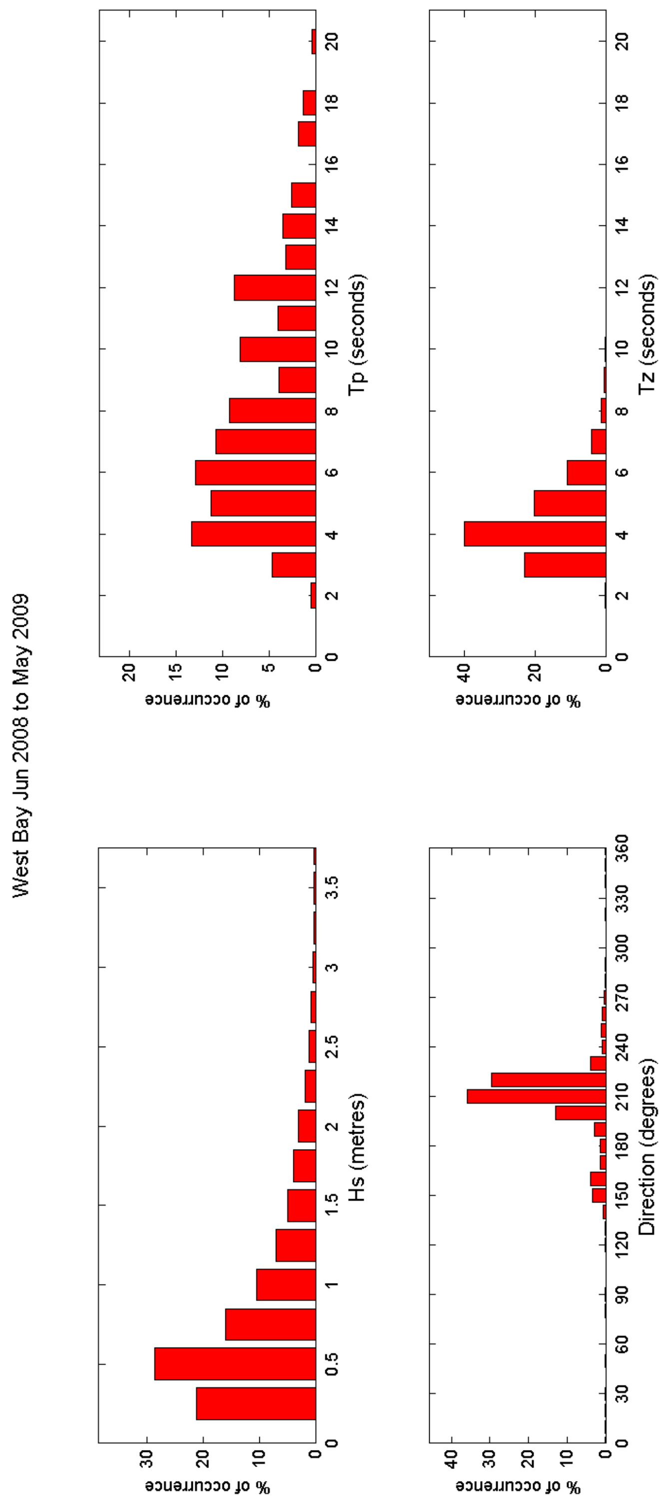
TASK2000 tidal prediction software was kindly provided by the Permanent Service for Mean Sea Level (PSMSL), Proudman Oceanographic Laboratory.

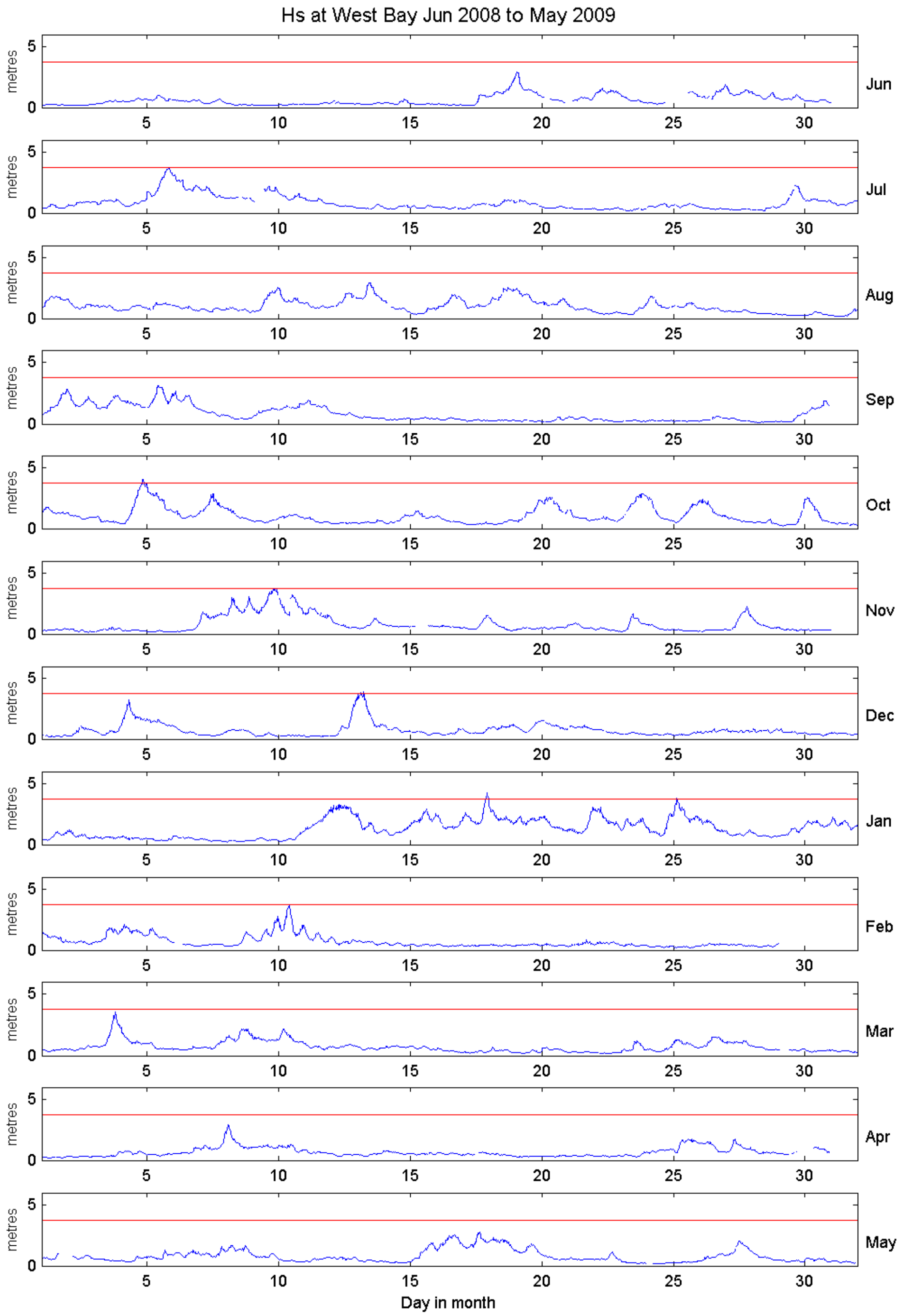


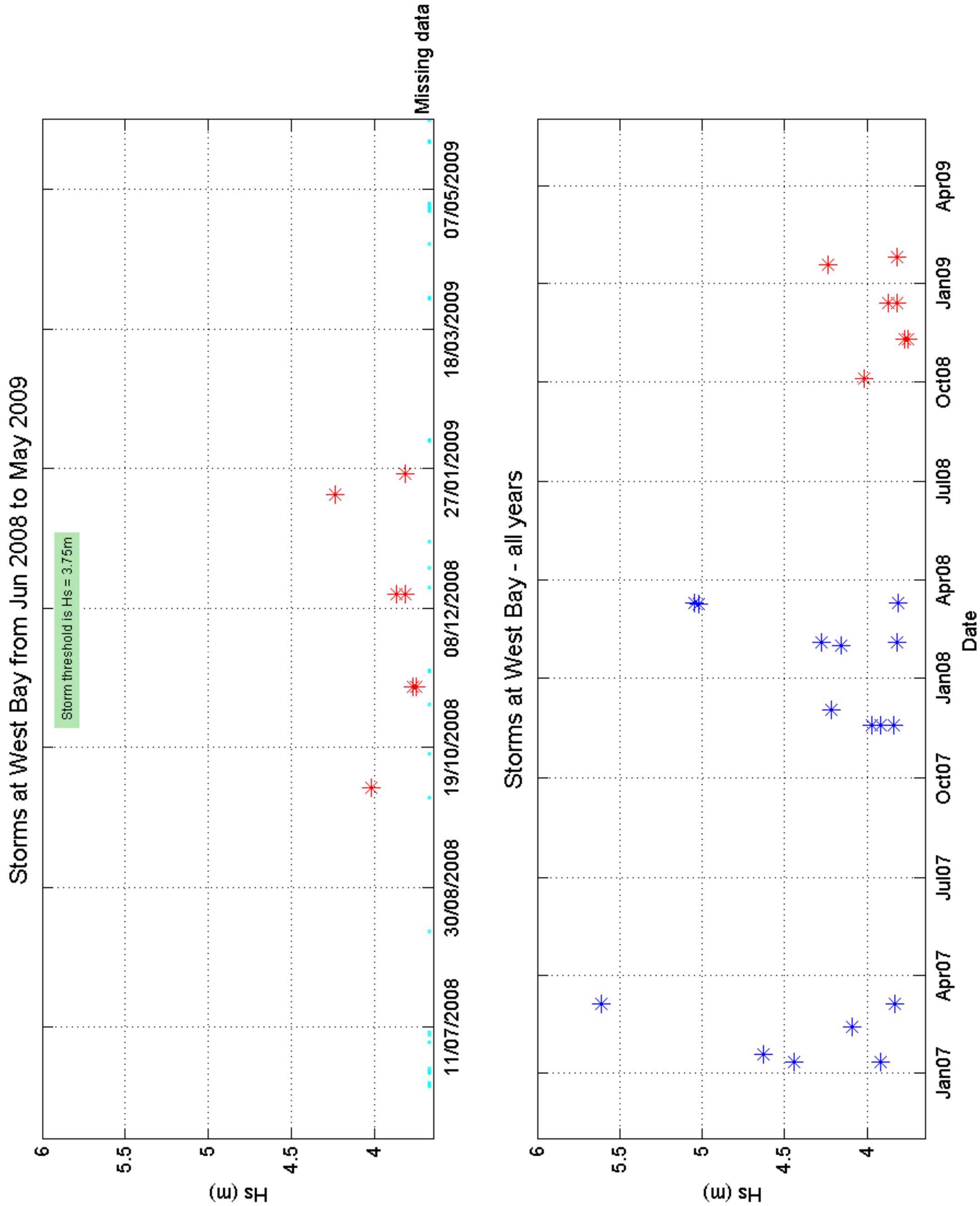
Percentage of occurrence of Direction vs. H_s for June 2008 to May 2009 (this reporting year)



Percentage of occurrence of Direction vs. H_s for November 2006 to May 2009 (all measured data)


West Bay Jun 2008 to May 2009
% of occurrence
Hs (metres)
Tp (seconds)
Direction (degrees)
Tz (seconds)


Hs at West Bay Jun 2008 to May 2009
metres
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Day in month


Storms at West Bay from Jun 2008 to May 2009
Storm threshold is Hs = 3.75m
Missing data
Hs (m)
6
5.5
5
4.5
4
11/07/2008
30/08/2008
19/10/2008
08/12/2008
27/01/2009
18/03/2009
07/05/2009
Storms at West Bay - all years
Hs (m)
Date
Jan07
Apr07
Jul07
Oct07
Jan08
Apr08
Jul08
Oct08
Jan09
Apr09

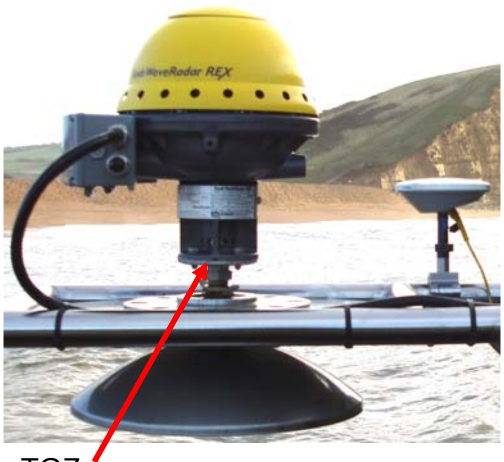
West Bay Harbour Tide Gauge

<u>Location</u>

OS:	346142.9E 90195.31N	
WGS84	*Latitude:* 50° 42.532' N	*Longitude:* 002° 45.846' E

West Bay Harbour, inner end of western breakwater

<u>Instrument</u>
Rosemount WaveRadar Rex



TGZ

Benchmark	*OS Co-ordinates*	*Description*
TGBM	4.607 OD	Top of horizontal S/S frame
TGZ =	4.647m above Ordnance Datum (Newlyn)	
TGZ =	6.897m above Admiralty Chart Datum	
TGZ =	0.040m above TGBM	

<u>Datum information</u>
Tidal elevations are measured reference to Ordnance Datum (Newlyn). The height of Chart Datum at Bridport relative to Ordnance Datum is -2.25m (Admiralty Tide Tables, Supplementary Table III).

<u>Survey information</u>
The site was last surveyed on 7 January 2008.

<u>Site Characteristics</u>
The breakwater is on open coast. Spring tidal range is 2.5m. Some wave reflection can occur around the breakwater and harbour entrance.

<u>Service history</u>
The radar became operational on 31 January 2008. No re-calibration of the instrument is required.

<u>Measurements</u>
The Rex is a Frequency Modulated Continuous Wave radar, sampling at 4Hz. Tidal elevations are derived, every 10 minutes, as the one minute average of the 4Hz readings. The time stamp is the start of the measuring burst.

Data Quality

C1(%)	Sample interval	Missing days
88	10 minutes	01-02 Mar, 01 May, 25 Jun, 01 Jul, 01 Oct, 01, 14, 20,21 Dec

Residuals and Elevations

Residuals and Elevations (OD and CD) for the whole year are shown in Figures 1 to 3 respectively. Tidal elevations are derived as the one minute average of the 4Hz readings. The time stamp is the start of the measuring burst.

Statistics

All times GMT

Month	Surge maxima		Surge minima	
	Value (m)	Date/Time	Value (m)	Date/Time
January	-	-	-	-
February	0.63	05-Feb-2008 00:30	-0.43	12-Feb-2008 05:40
March	1.10	10-Mar-2008 05:20	-0.47	04-Mar-2008 07:50
April	0.35	29-Apr-2008 20:20	-0.44	01-Apr-2008 18:00
May	0.20	28-May-2008 11:10	-0.31	05-May-2008 14:00
June	0.35	19-Jun-2008 01:30	-0.35	08-Jun-2008 15:40
July	0.54	05-Jul-2008 15:30	-0.31	23-Jul-2008 05:30
August	0.47	18-Aug-2008 12:00	-0.32	22-Aug-2008 18:10
September	0.58	05-Sep-2008 16:30	-0.37	26-Sep-2008 09:30
October	0.51	30-Oct-2008 02:00	-0.32	10-Oct-2008 07:10
November	0.54	10-Nov-2008 09:40	-0.48	24-Nov-2008 22:10
December	0.63	04-Dec-2008 04:40	-0.52	26-Dec-2008 23:40

Month	Extreme maxima		Extreme minima	
	Elevation (OD)	Date/Time	Elevation (OD)	Date/Time
January	-	-	-	-
February	2.16	23-Feb-2008 08:10	-1.94	10-Feb-2008 01:50
March	2.22	09-Mar-2008 07:00	-1.91	23-Mar-2008 00:30
April	2.16	08-Apr-2008 08:00	-2.03	07-Apr-2008 12:40
May	2.08	06-May-2008 19:20	-1.96	06-May-2008 12:10
June	2.07	04-Jun-2008 18:50	-1.68	06-Jun-2008 01:10
July	2.21	04-Jul-2008 19:30	-1.62	22-Jul-2008 14:20
August	2.22	03-Aug-2008 20:20	-1.79	04-Aug-2008 01:30
September	2.21	01-Sep-2008 20:00	-1.94	18-Sep-2008 01:20
October	2.17	16-Oct-2008 19:20	-1.76	17-Oct-2008 00:50
November	2.00	13-Nov-2008 18:20	-1.78	13-Nov-2008 23:50
December	2.09	13-Dec-2008 06:10	-1.79	15-Dec-2008 13:40

Month	Mean Sea Level	
	No. of days	MSL (OD)
January	-	-
February	29	0.194
March	29	0.207
April	30	0.192
May	30	0.192
June	29	0.170
July	30	0.249
August	31	0.255
September	30	0.232
October	30	0.266
November	30	0.237
December	27	0.156

10 Highest Values in 2008[1]			
Surge		Extreme	
Value (m)	Date/Time	Elevation (OD) (surge component)	Date/Time
1.10	10-Mar-2008 05:20	2.22 (-0.04)	09-Mar-2008 07:00
0.77	10-Mar-2008 03:30	2.22 (0.02)	03-Aug-2008 20:20
0.63	05-Feb-2008 00:30	2.21 (0.11)	04-Jul-2008 19:30
0.63	03-Feb-2008 15:50	2.21 (0.02)	01-Sep-2008 20:00
0.63	04-Dec-2008 04:40	2.18 (0.11)	09-Mar-2008 20:30
0.58	05-Sep-2008 16:30	2.17 (0.01)	16-Oct-2008 19:20
0.57	29-Mar-2008 18:30	2.17 (0.09)	05-Jul-2008 20:40
0.54	10-Nov-2008 09:40	2.16 (0.02)	15-Oct-2008 19:10
0.54	05-Jul-2008 15:30	2.16 (0.04)	18-Aug-2008 19:40
0.53	10-Nov-2008 14:10	2.16 (0.00)	10-Mar-2008 07:30

Year	Annual surge maxima		Annual extreme maxima		Annual Mean Sea Level (OD)	Recovery rate (%)
	Value (m)	Date	Elevation (OD) (surge component)	Date		
2008	1.10	10-Mar-2008 05:20	2.22 (-0.038)	09-Mar-2008 07:00	0.215	88

General

The time series of 10 minute tidal elevations for one year is quality-checked, flagged and archived. The archived time series is continuous and monotonic, with missing data given as 9999. The missing data shown are days where the entire 24 hours of data are missing.

Monthly extreme maxima/minima are the maximum and minimum water levels from all measured data for that month. Monthly surge maxima/minima (residuals) are calculated in a similar manner from the time series of residuals. Residuals are derived as the measured tidal elevation minus the predicted tidal elevation.

The monthly Mean Sea Level is calculated as the average of all readings for the given month. The annual MSL is the average of all readings for the given year. These average values should not be used for any purpose without consideration of the recovery rate.

Acknowledgements

TASK2000 tidal prediction software was kindly provided by Proudman Oceanographic Laboratory.

[1] Due to the requirements of the Harbour owners, the Rex is sited at a lower elevation than ideal, and a combination of high surge, high spring tides and significant wave action can cause the instrument to be swamped. This appears to have happened on 10 March 2008, and accordingly the elevations given in the tables below may be an under-estimate of the actual tidal levels.

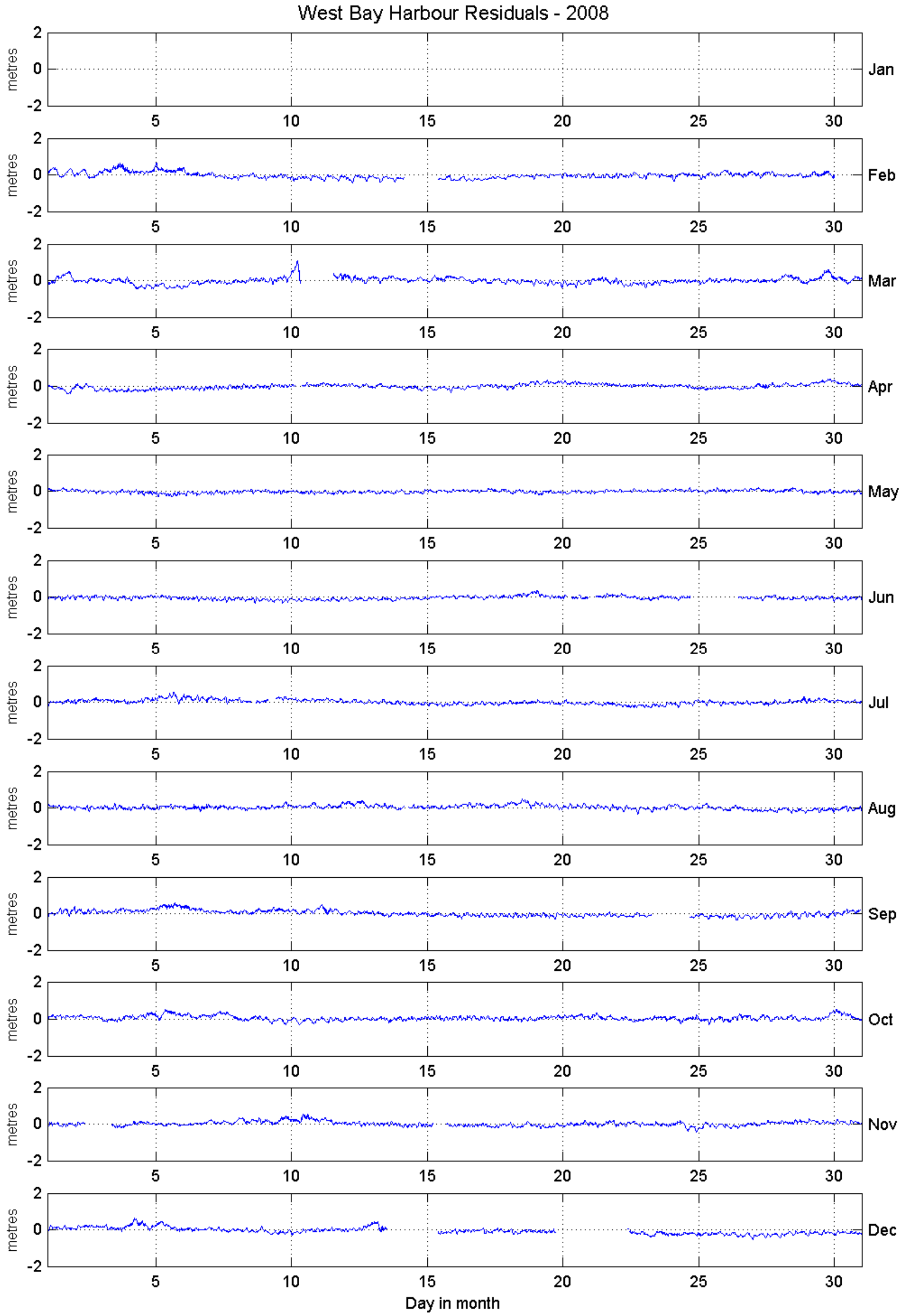


Figure 1 Residuals for 2008

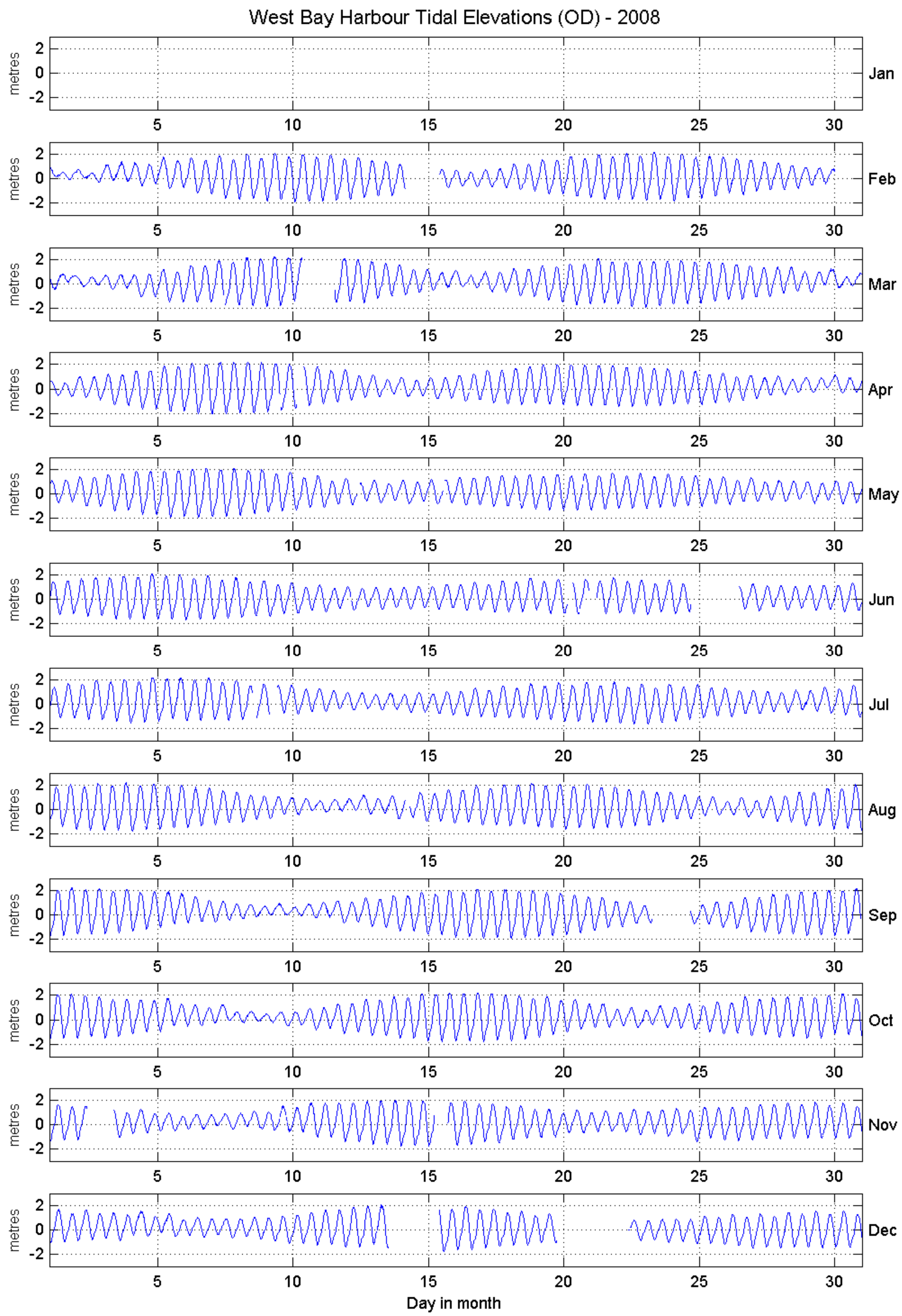


Figure 2 Tidal elevations relative to Ordnance Datum for 2008

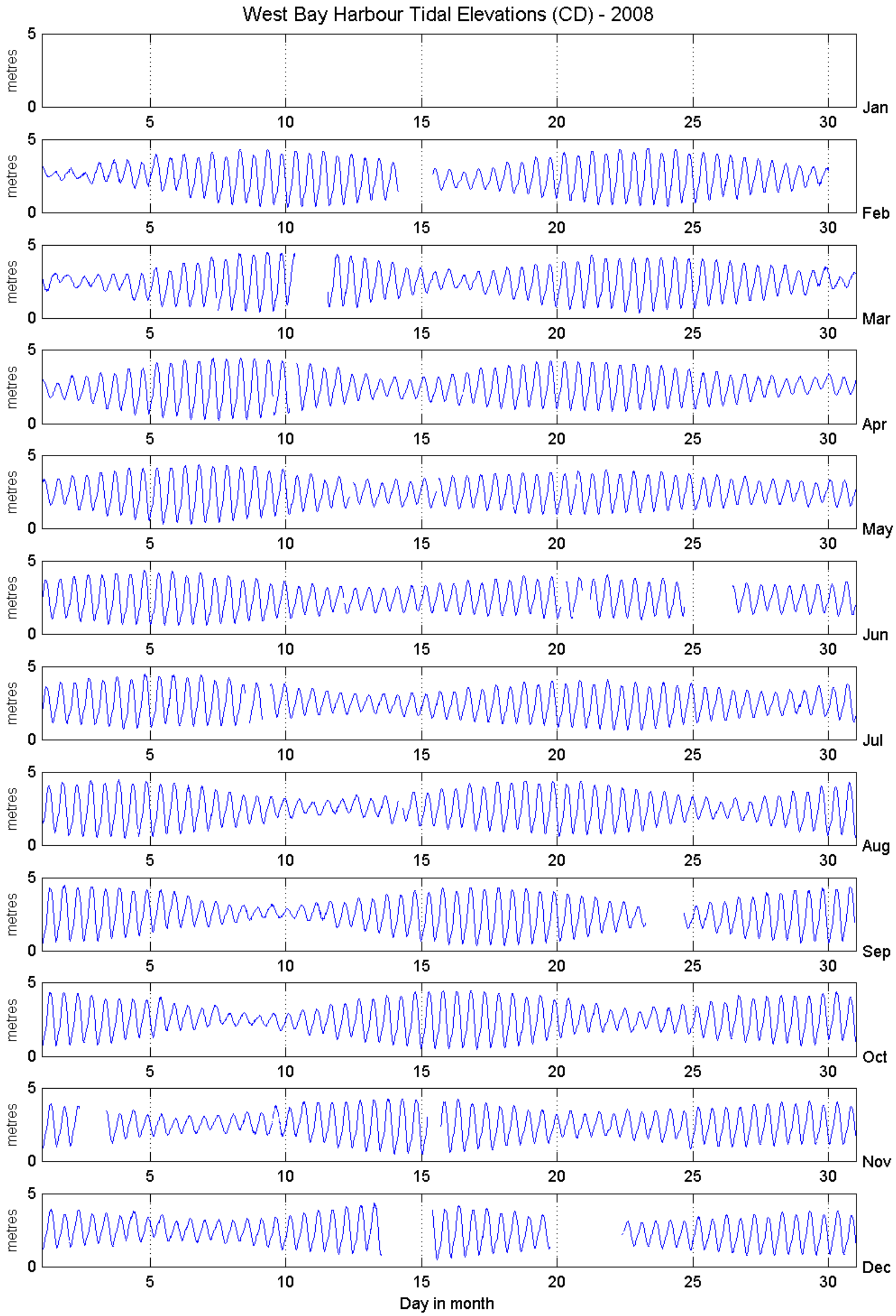


Figure 3 Tidal elevations relative to Chart Datum for 2008

Annex F – Topographic Survey Report for Lyme Regis

1. Introduction

Analysis has been conducted using annual baseline surveys collected since the Programme's commencement in 2007. A full time series of plotted beach profiles are shown superimposed on and relative to a Master Profile for each profile location (on the accompanying CD). The Master Profile provides the basis for calculation of beach cross-section area changes. In general, changes are measured relative to the Mean Low Water Springs (MLWS) level. In cases where this level cannot be reached, the Master Profile is placed at the lowest level achieved by all profiles in the management unit (Figure 1). The trend in cross-sectional area (CSA) is presented as a graph for each profile (Figure 2).

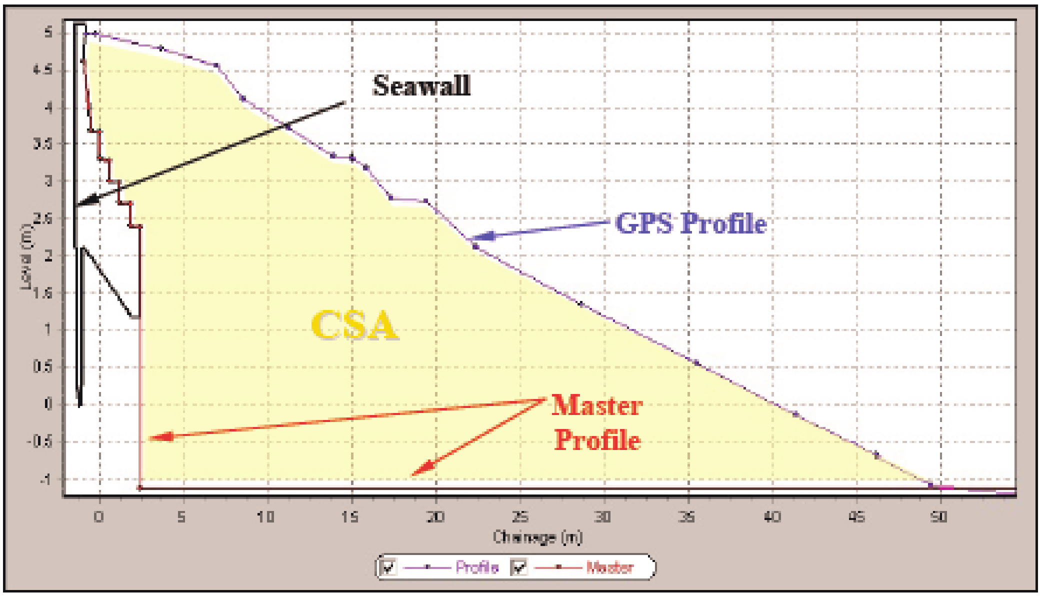


Figure 2: Example Master Profile with CSA calculated from the surveyed GPS Profile

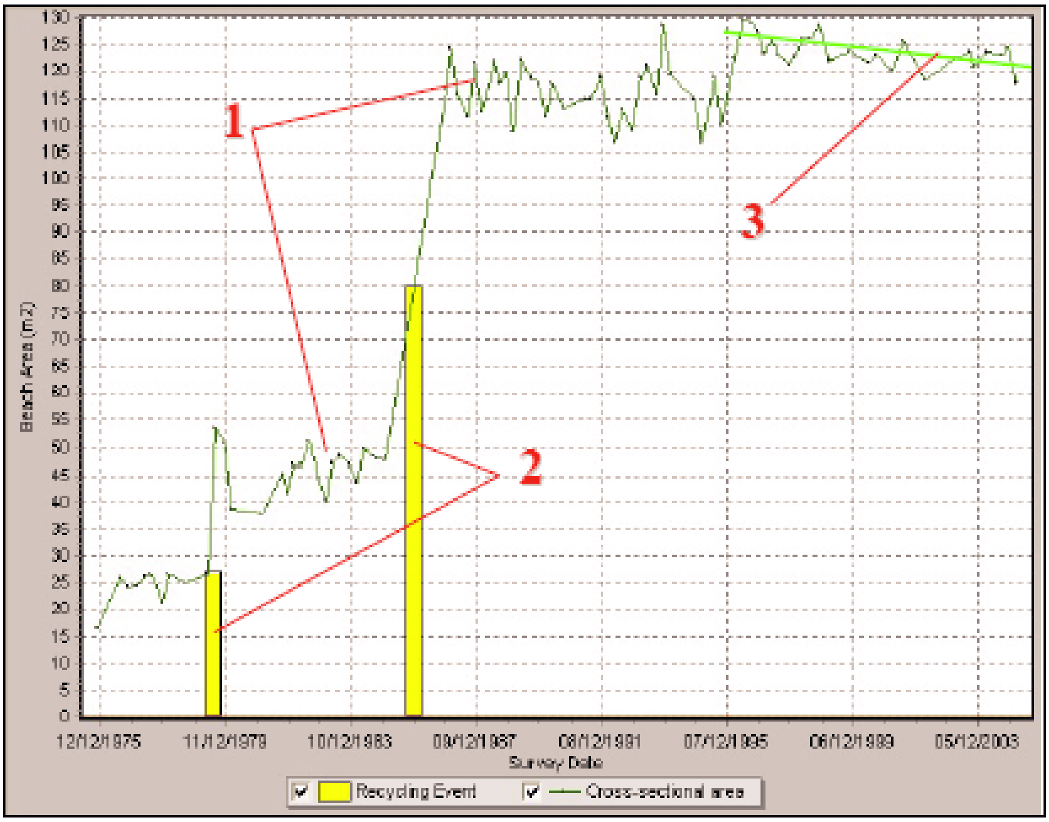


Figure 3: Example of Beach Profile Trend Analysis
1. Beach Cross-Sectional Area (CSA)
2. Replenishment Activities
3. Mathematically Derived Trend line

As part of the monitoring programme specification, beach management plan (BMP) surveys are conducted for Lyme Regis annually. BMP surveys include a full profile survey at 50m intervals and continuous spot height data collected at approximately 1m intervals across the whole beach to the level of MLWS. This continuous data also includes a feature code for each spot height data point recorded. The feature code data is used to provide a sediment distribution map.

A topographic difference model has been produced based on the spot height elevations for each BMP survey. The spot height data has been processed into a grid model and successive models have been subtracted from one another to produce a difference model for the management unit. The spot height data from each survey has also been used to approximate the level of MHW (Mean High Water) and MLW. Topographic difference models using historic data have also been produced. Due to gaps in the West Dorset District Council data, TIN datasets were processed from the historic profile data. These have then been converted into a grid model and successive models have been subtracted from one another to produce a difference model. Difference models using this method are not as accurate as those obtained from continuous baseline data, therefore caution is advised.

2. Introduction

The historic data collected by West Dorset District Council has been included in this report to provide a more comprehensive analysis for Lyme Regis. Topographic profiles used by West Dorset District Council correspond to profiles used by Plymouth Coastal Observatory. Data has been analysed from summer 2006 to summer 2011. Data analysis is limited to those profiles which have historic data.

3. Condition of process sub-cell

The Beach Change Summary maps contain an at-a-glance condition of Lyme Regis, with the lines representing the average accretion, no change or erosion for where there is topographic data.

Spring 2010 to Spring 2011

There has been little change throughout the management unit,

Historic summer 2006 to summer 2010

A mixture of accretion and erosion can be observed throughout the management unit. The majority of the accretion can be seen over areas with underlying bedrock and within the harbour.

4. Storm Event Performance

During the reporting period one post storm survey has been undertaken at Lyme Regis.
The Post Storm profiles of 17th November 2009 can be compared with the autumn profiles surveyed on the 22nd September 2009, which represents the pre storm profile.

22nd September 2009 to Post Storm survey 17th November

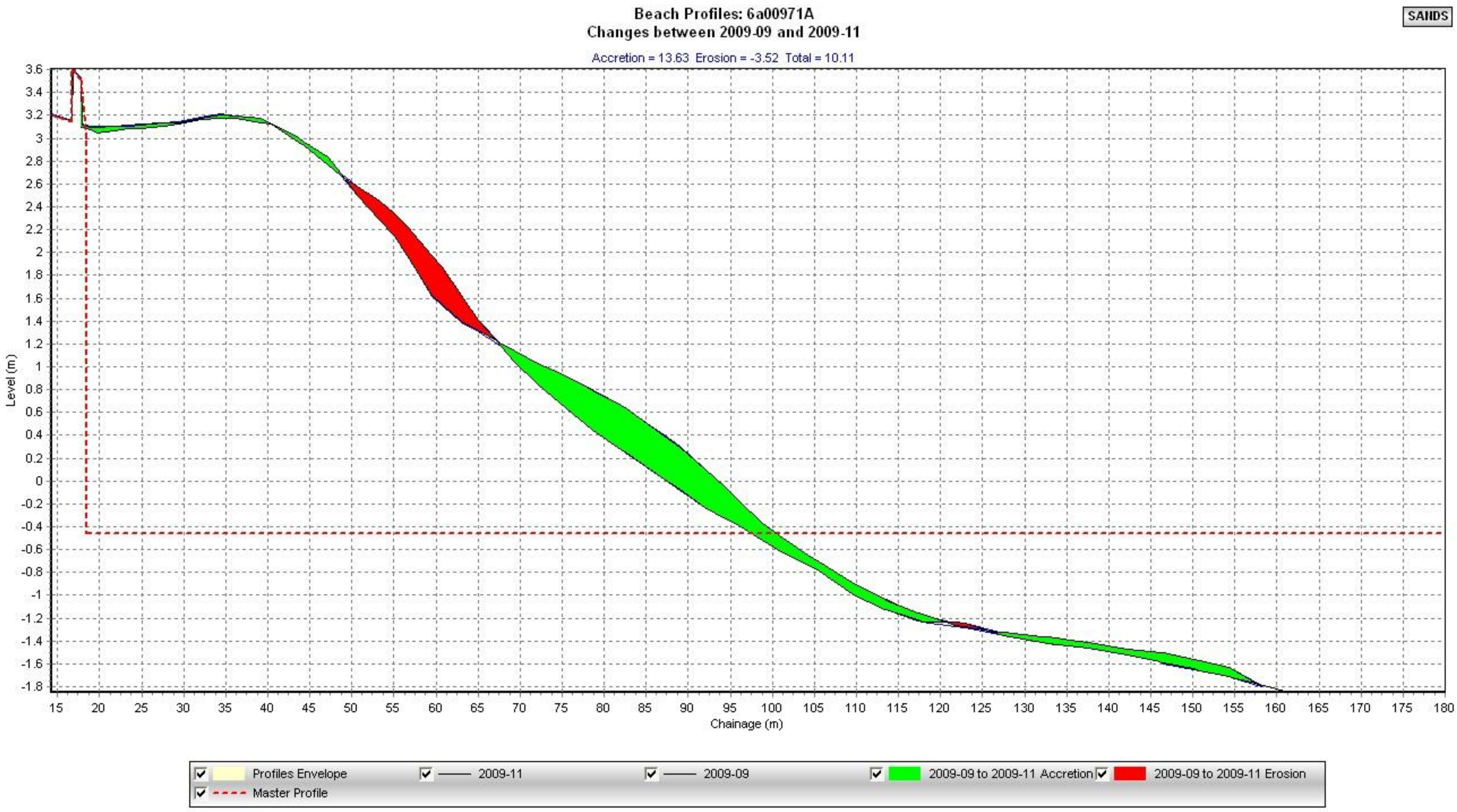


Figure 4. Profile 6a00971A pre-storm and post-storm difference

Profile 6a00917A is situated on the sandy beach adjacent to the Cobb. There has been some slight accretion at the seawall and some erosion below the beach crest, suggesting the gain of material at the seawall is a result of the beach crest being pushed back.

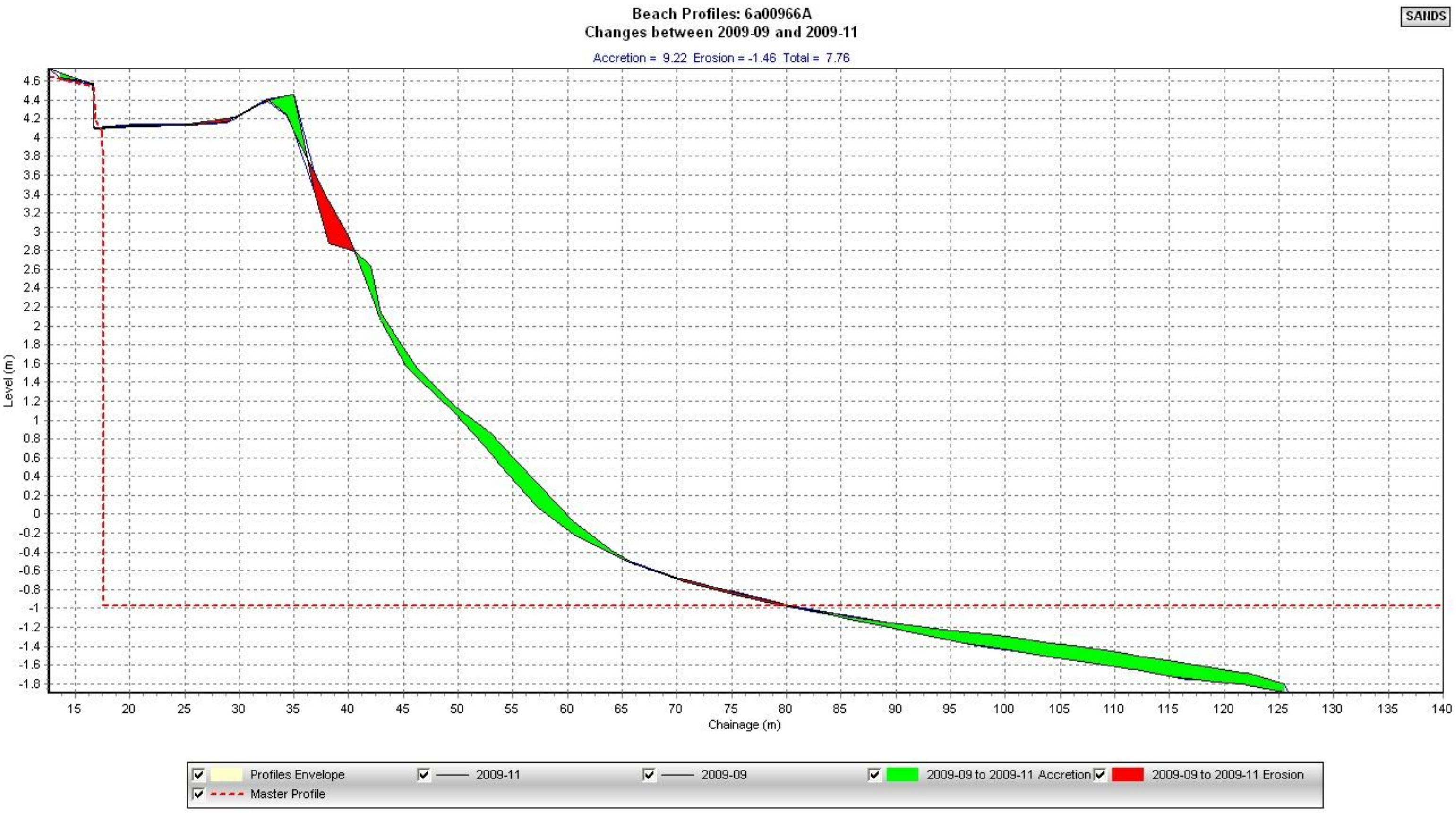


Figure 5. Profile 6a00966A pre-storm and post-storm difference

This profile is situated on the shingle section of beach adjacent to the Lister Gardens Groyne. Accretion is not as pronounced as the previous profile situated on the sandy beach; this is probably due to the reduced mobility of the material at this location. The profile here is steeper and higher in elevation than the previous profile. There is some scour at the seawall.

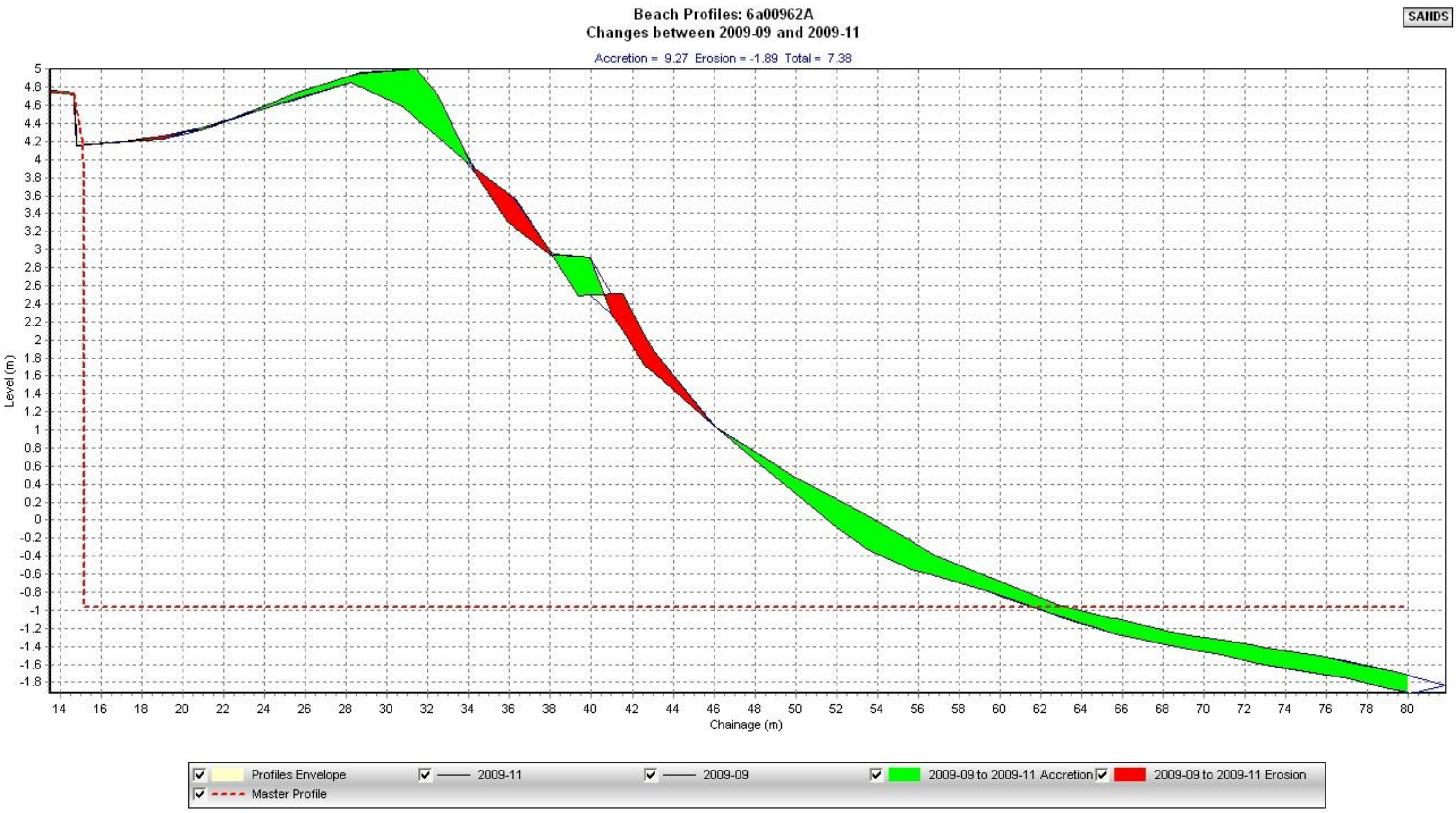


Figure 6. Profile 6a00962A pre-storm and post-storm difference

This profile is located at the eastern end of the shingle Cobb Beach. The beach crest here has become 0.5 metres higher than the pre-storm profile. Erosion can be observed in the mid section of the profile. It is possible this lost material has been pushed up the beach contributing to the increase in crest height. There is evidence of minor scour at the base of the seawall.

6. Topographic difference models

July 2006 to November 2006

A band of erosion can be observed along the central section of shingle beach. Accretion is present at the foreshore around Beacon rocks. The volume lost over the four month period is equal to 3% of the initial July 2006 beach volume.

Net Sediment Balance above MLWS from July 2006 and November 2006: ***-2589.66 m^3***

July 2006 to May 2008

A large section of accretion can be observed along the base of the seawall. The trend for erosion is the same as above.

Net Sediment Balance above MLWS from 2006 to 2008: ***+3667.32 m^3***

July 2006 to April 2010

In the long term the shingle crest has retreated, depositing material against the seawall. A small amount of material has been deposited around Beacon Rocks. The sandy beach has experienced some small isolated areas of erosion. The amount of material lost during the last four years is negligible, equating to less than 1% of the July 2006 volume.

Net Sediment Balance above MLWS from 2006 to 2010: ***-925, 63 m^3***

8. DTM Volumetric change graph

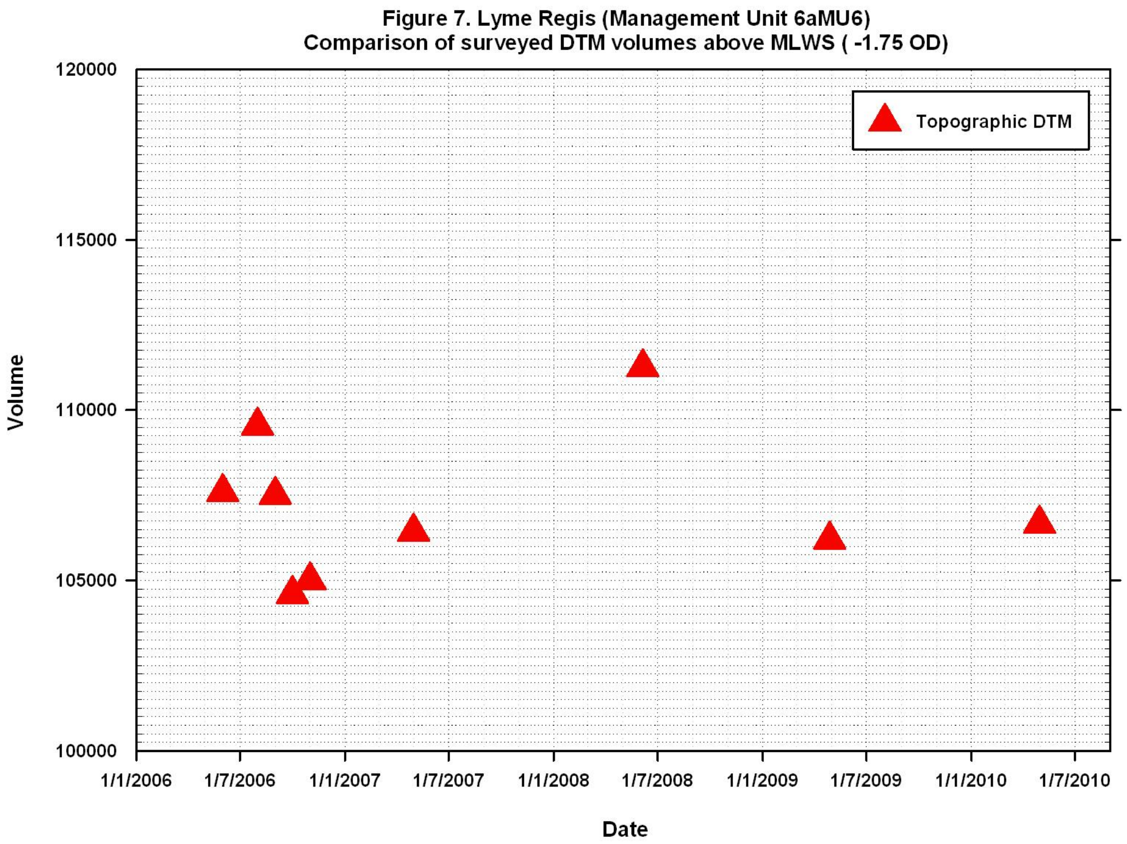


Figure 7. Comparison of surveyed DTM volumes above MLWS

The beach at Lyme Regis has remained relatively stable over the last five years. The gain of material in 2008 is a result of beach nourishment works. From 2008 onwards the beach has stabilised.

9. Trigger point graphs

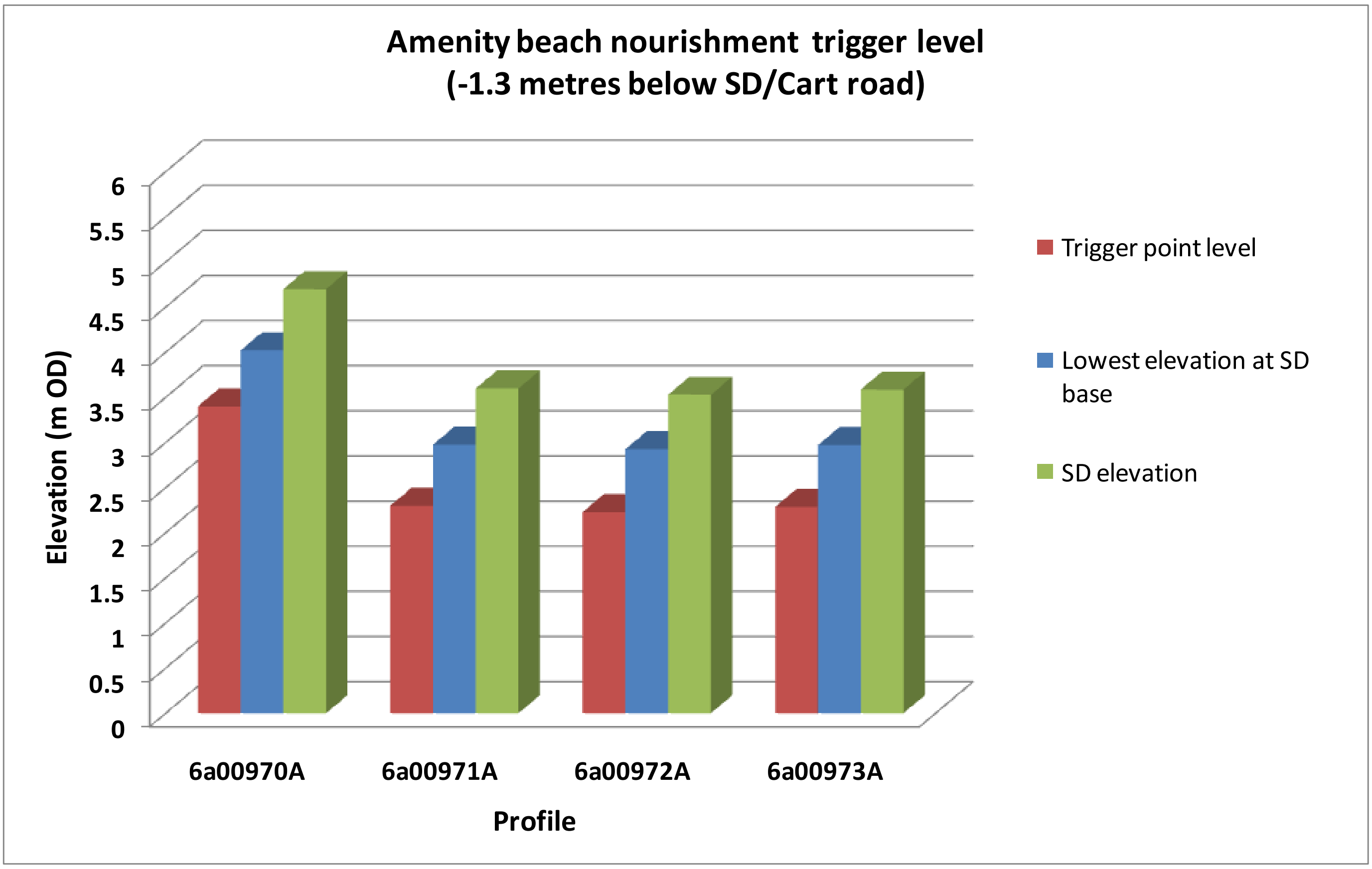


Figure 8. Amenity beach nourishment trigger level (-1.3 metres below the sea wall/Cart road)

During the last four years the sand amenity beach has not reached the designated trigger point (-1.3 metres below the sea wall/Cart road)

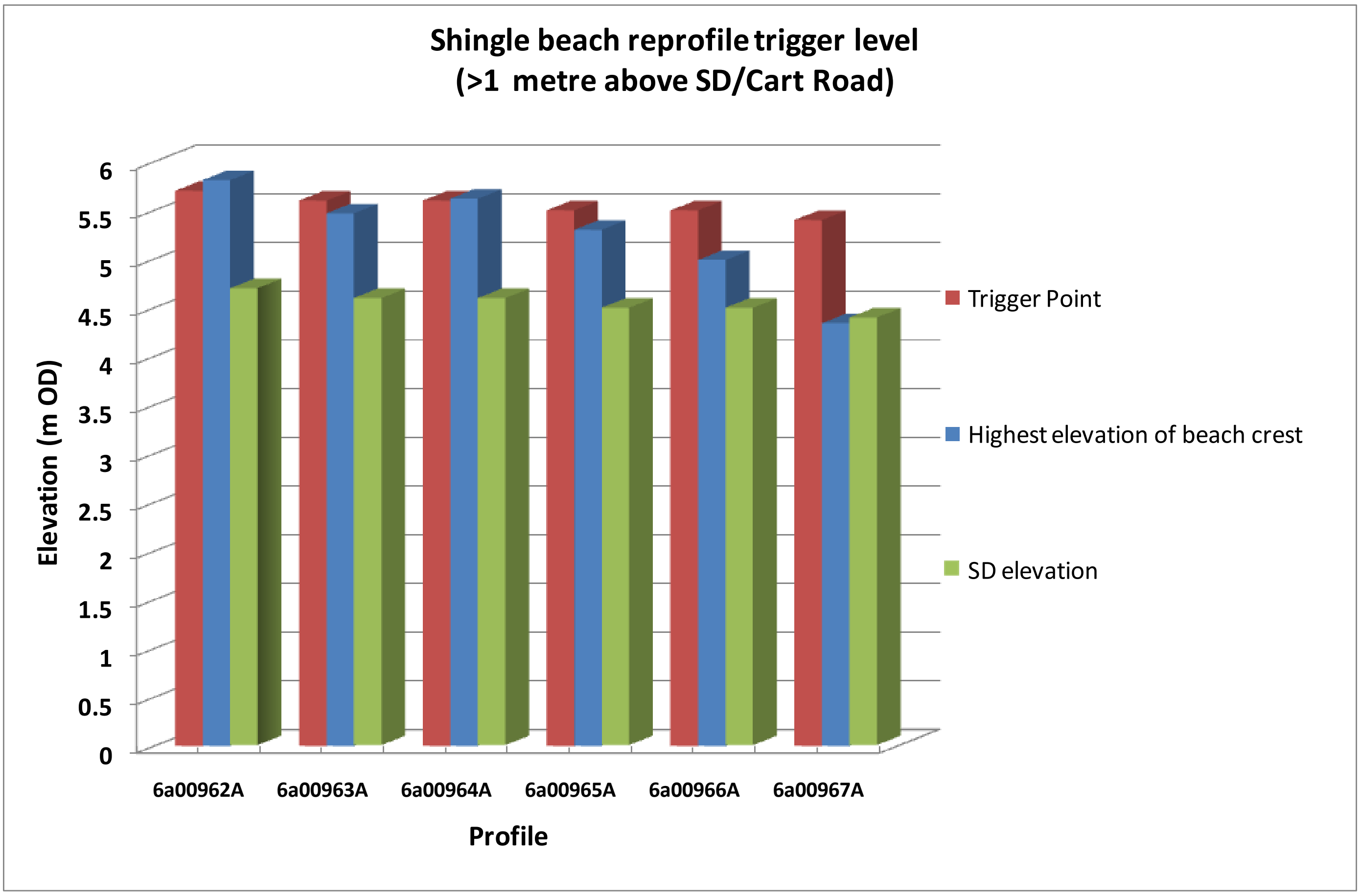


Figure 9. Shingle beach re-profile trigger level (>1 metre above the seawall/Cart road)

Profiles 6a00962A and 6a00964A situated at the eastern end of the shingle beach, both have a crest height above the 1 metre trigger point. The maximum level reached over this is 11cm. Both of these instances took place during the first December following the initial post scheme surveys. It is possible that a storm event pushed the beach crest above the trigger point in these locations; further examples of this can be seen in the previous pre and post storm difference graphs.

10. Changes in MHW elevation

Since 2007 the MHW contour has generally moved landwards along the western part of Cobb Beach, suggesting erosion. In the east this pattern is reversed and accretion can be observed. Church Cliffs appears to have undergone erosion since 2007.

11. Profile behaviour

Shingle profiles (6a00960A to 6a00968A) are more inclined than those in the sand section of the beach. Shingle profiles have slope ratios ranging from 1:2 to 1:13. Profiles become progressively less steep westwards. Profiles located in the sand section of beach do not seem to become steeper than 1:8. Slopes are on average approximately 1:14, corresponding with the original design profile in the 2007 BMP report.

12. Coastal Works

At present the phase IV scheme (East Cliff) has now received planning permission. West Dorset County Council is currently looking to progress with the final design detail.

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EXPLANATORY NOTES

Change in Cross-sectional Area (CSA)

The annual change in cross-sectional area is calculated as the difference in CSA between two surveys, expressed as a percentage change compared to the earlier CSA.

$$\frac{CSA_1 - CSA_2}{CSA_2} \times 100 \quad \text{eqn}(1)$$

Where CSA_1 = most recent springtime survey and CSA_2 = spring survey previous year. Therefore an annual change of –14% represents erosion during the last year of 14% of the area of last year's survey.

Net Sediment Calculation

The value derived from this calculation represents the volume change in m^3 across each individual management unit over time. The initial volumes are derived from the Digital Terrain Models made for consecutive baseline topographic surveys. Both models are clipped to cover the same area, then and a volume above the MLWS plane is calculated for each DTM. The net sediment change is calculated as

$$Vol_1 - Vol_2 \qquad \text{eqn}(2)$$

Where Vol_1 = most recent DTM model volume and Vol_2 = earlier DTM model volume. Therefore a net change of –19730m^3 represents erosion since the earlier survey.

Actual Change in Cross-sectional Area (Spring 2010 to Spring 2011)
Accretion
> 30 m2
15 - 30 m2
5 - 15 m2
No Change
Less than 5 m2
Erosion
5 - 15 m2
15 - 30 m2
> 30 m2
MU boundary
7d01323 (3 %)
Annual Change in Cross-sectional Area (%)
6a00949 (0%)
6a00953 (1%)
6a00955 (-2%)
6a00962A (2%)
6a00964A (-3%)
6a00966A (0%)
6a00968B (5%)
6a00971A (-2%)
6a00973A (0%)
Aerial Photography from 2009
N
0
150
300
m


Actual Change in Cross-sectional Area (Summer 2006 to Summer 2011)
Accretion
> 30 m2
15 - 30 m2
5 - 15 m2
No Change
Less than 5 m2
Erosion
5 - 15 m2
15 - 30 m2
> 30 m2
MU boundary
7d01323 (3 %)
Annual Change in Cross-sectional Area (%)
6a00964A (-10%)
6a00965A (-5%)
6a00966A (11%)
6a00970A
6a00971A
6a00972A (-10%)
6a00973A (-5%)
6a00974A (40%)
0
150
300
m
N
Aerial Photography from 2009


Change in Elevation (m) between
July 2006 and November 2006
>= 3
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0.25 - 0.5
-0.25 - 0.25
-0.5 - -0.25
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
<= -3
ACCRETION
NO CHANGE
EROSION
Model Extent
6a00962A
6a00964A
6a00966A
6a00967A
6a00970A
6a00972A
6a00973A
Aerial Photography from 2009
0
150
300
m
N


Change in Elevation (m) between
Febuary 2008 and April 2010
>= 3
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0.25 - 0.5
-0.25 - 0.25
-0.5 - -0.25
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
<= -3
ACCRETION
NO CHANGE
EROSION
Model Extent
6a00962A
6a00964A
6a00966A
6a00967A
6a00970A
6a00972A
6a00973A
Aerial Photography from 2009
0
150
300
m
N


Change in Elevation (m) between July 2006 and April 2010
>= 3
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0.25 - 0.5
-0.25 - 0.25
-0.5 - -0.25
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
<= -3
ACCRETION
NO CHANGE
EROSION
Model Extent
6a00962A
6a00964A
6a00966A
6a00967A
6a00970A
6a00972A
6a00973A
Aerial Photography from 2009
N
0
150
300
m


Contours
MHW Elevation: 1.35 OD
MLW Elevation: -1.20 OD
MHW 2009-10
MHW 2008-02
MHW 2009-03
MHW 2007-03
MLW 2009-10
Aerial Photography from 2009
0
150
300
m
N


Sediment Type
Gravel
Gravel & Sand
Sand
Boulder
Dune
Dune Vegetated
Grass
Gravel & Mud
Mud
Mud & Sand
Rock
Saltmarsh
Sea Defence
Shell
Water Body
Mixture
Obstruction
Aerial Photography from 2009
0
150
300
m
N


Elevation
Metres OD
-1 - 0
-2 - -1
-3 - -2
-4 - -3
-5 - -4
-6 - -5
-8 - -6
-10 - -8
-12 - -10
-20 - -12
-40 - -20
Aerial Photography from 2009
0
150
300
m
N